Abstract

This paper examines the publication of quality indicators in service markets with public finance systems, such as education and healthcare markets. We provide a model in which the reporting of such indicators increases consumers’ decision weight on quality relative to other attributes (such as prices and horizontal match) and study the effects in two market environments: markets with regulated prices and markets with unregulated prices. We find that the publication of quality indicators increases quality investments by service providers, but also leads to higher prices and less product variety. Consumer and total welfare may decrease with such policies, in particular when consumers are heavily subsidised.

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1 Introduction

Public service markets, such as education and health, are important segments of any economy. Take healthcare as an example. The annual total expenditure in most European countries in recent years (2011–2013) is around 11% of their GDP, whereas as much as 17% of the GPD is spent on healthcare in the United States (World Bank, 2017). Yet, services such as healthcare and education are often inherently complex and consumers normally find it difficult to compare different alternatives due to their multi-attribute nature, the lack of relevant information and the need of professional knowledge.\footnote{Healthcare and education services are prime examples of so-called credence goods (Darby and Karni, 1973). Such services are characterised by asymmetric information between the service provider and the customer (see Dulleck and Kerschbamer, 2006, for an overview).}

To help consumers make better choices, authorities have been keen on making service providers’ performance information more accessible to the public. For example, in the context of English hospitals, the Department of Health and NHS England publish information about A&E Attendances and Emergency Admissions performance, Mortality rate, “Recommended by staff”, Infection control and cleanliness, Waiting time, and Inpatients’ friends and family satisfaction, etc. For English universities and other higher education institutions, the Research Excellence Framework (or REF) evaluates their research impact, whereas the recently introduced Teaching Excellence and Student Outcomes Framework (or TEF) assesses and publishes the quality of their undergraduate teaching.\footnote{Similar quality scores have been published in many other markets. Examples include hospitals (e.g., US, UK, Germany, Italy), doctors (e.g., UK) and nursing homes (e.g., US, UK, Germany).}

On the one hand, releasing such information helps consumers better assess the quality of the service that they will likely receive and thus increases the competitive pressure among providers. On the other hand, the exposure to such performance information makes quality concerns more salient in consumers’ decision process (Bordalo et al., 2013). For instance, although the mortality rate may capture certain aspects of hospital quality, it may draw undue attention from patients (relative to other attributes).

In this paper, we study the effects of publishing provider quality information on the outcomes of such public service markets. To this end, we let
consumers’ decision weight on service quality be influenced by the publication of quality data such that more information provision leads to a higher decision weight. We analyse a two-stage market game in which in the second stage, providers compete to serve the demand, and in the first stage, entry is determined by a zero-profit condition. In this framework, we study how information provision affects service quality, prices, variety, consumer surplus and social welfare. In particular, our focus is the long-run effects of information provision, where providers can enter the service market by incurring an entry cost to overcome entry barriers, or exit the market when suffering losses.

Recent studies have provided us important knowledge of public service markets with an exogenously given market structure (see, e.g., Brekke et al., 2006, 2010). Heavy regulatory and natural restrictions on entry are the often cited reason for an exogenous number of firms. However, high entry barriers do not necessarily imply that the number of providers is independent of incumbents’ financial outcome. In this paper, we capture the height of an entry barrier by its implied entry cost, and allow for market entry and exit in the event of excessive profits and losses, respectively.

Studying an endogenously determined number of providers bears important advantages. First, models restricting entry and exit may offer biased welfare results, because important welfare effects from variety are completely ignored. Second, the observed number of providers in many countries does change significantly over time. For example, the number of hospitals in many European countries has generally been in the decline in the last two decades. Figure 1 shows the number of hospitals in France, Germany and Italy in recent years using data from the World Health Organization (2017).

We consider two regimes depending on whether price is regulated or not. Both regimes are common in service markets. For example, hospitals normally face strict rules on how they can charge for their services. In many countries, hospitals are often compensated through a diagnosis-related group (DRG) payment system. In contrast, in markets such as senior care homes and nursing homes, providers normally have a larger degree of freedom in setting prices than hospitals do. Not to unnecessarily restrict our study to a particular type of market, we find it important to understand the effects of information provision under both regimes.
In the unregulated market, we find that releasing quality indicators has the intended effect of raising service quality. However, higher quality implies larger investment in quality and hence reduces provider profitability. Under endogenous entry, this means fewer providers entering the market which can have detrimental effects of higher prices and lower welfare. Indeed, we find increasing exposure to quality information improves consumer surplus when consumers’ initial decision weight is relatively low. However, when consumers put a high weight on service quality, consumer surplus decreases with further exposure to quality information. It is in this sense, we demonstrate that publishing quality indicators may bring about over exposure to quality information. A similar pattern applies to social welfare. Interestingly, the negative effects of quality information exposure are more likely to occur when consumers are more heavily subsidised, as in such cases providers mainly compete on quality.

This inverted u-shaped relation between the publication of quality indicator and welfare also holds in the regulated market. However, the scope for detrimental effects is much smaller in the regulated market, because with exogenous prices consumers do not pay more when the decision weight on quality increases. In addition, when the price is optimally regulated,
the regulator can fine-tune the price to either boost the positive effects or mitigate the adverse effects of increasing quality information exposure. This is reflected in the observation that the optimally regulated price increases with consumers’ decision weight on quality when it is initially low, whereas the price decreases when quality is already high. In this regard, regulatory agencies can coordinate their policies on price regulation and on the release of quality information.

With exogenous prices, the publication of quality indicators has the expected effects of stimulating service quality and discouraging entry as in the unregulated market. Interestingly, however, these effects are no longer monotonic when the price is optimally regulated. The reason is that when the quality decision weight becomes large in consumers’ decision process, the regulator can revise the regulated price to counter its adverse effects. As a result, further exposure to quality information reduces the regulated price which in turn can reduce market quality and may increase entry.

**Related literature**

A number of recent papers have studied the effects of reporting quality scores focusing on healthcare markets. Gravelle and Sivey (2010) examine the effects in a setting in which consumers are imperfectly informed about the quality of the healthcare product and prices are regulated. They find that better information only leads to higher quality provision if firms differ not too much in the costs of providing quality.

Ma and Mak (2014) consider a good with two qualities. While all consumers have the same valuation of the first quality, their valuations of the second vary and are their private information. In this setting, the authors compare Full Quality Report and Average Quality Report, and find that the latter yields the first-best prices and qualities. Ma and Mak (2015) study an insurer’s optimal reporting policy and payment method, simultaneously. The authors show that the first-best can be implemented by either prospective payment or cost reimbursement method. However, the associated reporting policies differ. Finally, Mak (2017) studies firms’ service decisions, in particular decisions on the dumping of consumers with certain characteristics, under
various reporting regimes.\(^3\)

Our approach differs from the above papers in that we consider that consumers’ decision focus is affected by the publication of quality indicators and that we introduce horizontal product differentiation. While the modelling of information has been kept intentionally simple, our framework with horizontal differentiation allows us to study how the publication of quality indicators affects a provider’s choice of quality and price, and the level of variety provided in the market in equilibrium. Thus, our welfare results bear more relevance in the long run.

The aspect of quality and competition has been theoretically investigated by a number of studies, often employing a model of spatial product differentiation. For example, Brekke et al. (2006) extend the Hotelling model such that, for regulated prices, firms choose their locations and the quality of their products. Bardey et al. (2012) analyse the regulation of payment schemes (a prospective payment per consumer and a cost reimbursement rate) for healthcare firms competing in both quality and product differentiation in a Hotelling framework. Brekke et al. (2017) examine the effects of mergers on quality provision in healthcare markets (with and without regulated prices). Relatedly, Brekke et al. (2011) examine quality provision with semi-altruistic firms. See also Gaynor (2007) for a review.

Our innovation in relation to this strand of literature is three-fold. First, we study the effects of changes in consumer decision focus on quality provision. Second, we endogenise the number of firms in the market, and hence, are able to provide a long-term analysis of market quality. Third, we demonstrate that our analysis applies more broadly to service markets with public finance systems in general.

On a more general note, the aspect of product quality in spatial models of competition has been analysed in a variety of papers. For instance, as far as the relationship between entry and quality is concerned, Economides (1993) shows that adding competition in quality to the standard setup results in more entry and underprovision of quality compared with the socially optimal solution. Brekke et al. (2010) stress the importance of income effects

\(^3\)We note that earlier contributions studied quality provision and price competition in a consumer search model without horizontal differentiation (see, e.g., Chan and Leland, 1982 and Dranove and Satterthwaite, 1992).
for the relationship between competition and quality. The presence of income effects may lead to a positive relationship between the (exogenous) number of firms and equilibrium quality. The current paper adapts their approach and studies the effects of publishing quality information in public service markets.

Finally, our paper contributes to the discussion of whether or not the free market provides optimal variety when products are differentiated. While it is often agreed that entry is excessive within the standard Salop framework (Vickrey, 1964; Matsumura and Okamura, 2006b), recent studies have demonstrated that entry can be insufficient, for example, when consumers are not necessarily uniformly distributed (Calvó-Armengol and Zenou, 2002), when entry cost is high (Matsumura and Okamura, 2006a) or when demand is price elastic (Gu and Wenzel, 2009; Gu et al., 2016). The current paper, however, presents a new mechanism for the possibility of insufficient entry to arise. We show that with firms competing on both prices and qualities, entry is insufficient when consumers’ decision weight on quality is above a certain threshold. More interestingly, this threshold decreases when consumers are more heavily subsidised implying that entry is more likely to be insufficient when a more generous public finance system is introduced.

The remainder of the paper is organised as follows. Section 2 describes our model setup. Section 3 contains the analysis when providers are free to set prices, and Section 4 considers the case where prices are regulated. Section 5 concludes the paper.

2 The model

2.1 Consumer behaviour

Consider a market for a differentiated product. There is a measure one of consumers who are located uniformly along a circle of circumference one (Salop, 1979). A consumer who is located at \( x \) and who buys from firm \( i \) at location \( l_i \) derives utility

\[
u(p_i, q_i, x) = v + q_i - \gamma p_i - t| x - l_i |,
\]
where \(v\) is the gross utility from consuming the product. We assume that \(v\) is sufficiently large such that the market is covered and every consumer purchases the product. The quality and the price of the good are denoted by \(q_i\) and \(p_i\) respectively, and \(t\) is the transport cost per unit of distance travelled.

There is a public finance system in place so that a consumer only pays a share \(\gamma \in [0, 1]\) of the total price. Borrowing from the healthcare literature, we call \(\gamma\) the co-payment level faced by a consumer. The remaining share, \(1 - \gamma\), is covered by the public finance system. This could be, for example, a government financed insurance system in the context of healthcare markets, subsidised student loans in higher education markets, or the “cash for care” scheme in senior care markets (see, e.g., Ungerson, 2004). The case \(\gamma = 1\) corresponds to a situation without government subsidies which means that a consumer pays the full price, whereas \(\gamma = 0\) is a situation in which the product is provided to consumers free of charge.

In many situations, quality is difficult to assess in practice and quality perceptions are often imperfect. It is also known that consumers have difficulties in correctly assessing the relative importance of different attributes of a product. In our case, a consumer faces the difficult task of comparing diverse attributes such as the quality of product, its price and its horizontal match (i.e., the location). In the model, we take into account that a consumer might not correctly make comparisons across attributes by introducing a decision weight \(\lambda > 0\). This decision weight \(\lambda\) measures the extent to which consumers focus on quality in their decision making and we posit that, when deciding, a consumer acts as to maximise the following perceived utility \(u_p\):

\[
 u_p(p_i, q_i, x) = v + \lambda q_i - \gamma p_i - t|x - l_i|.
\]

Perceived and experienced utility could differ, and the decision weight \(\lambda\) may be smaller or larger than one. In cases where \(\lambda < 1\), a consumer undervalues quality relative to price and fit, and in cases with \(\lambda > 1\), a consumer attaches too much weight on quality. When \(\lambda = 1\), a consumer evaluates quality correctly, and we have \(u_p = u\).

In the analysis below, the decision weight \(\lambda\) will be one of our key parameters. We think of policy interventions such as publishing quality indicators (on care homes, hospitals, universities, etc.) as increasing the saliency of quality
in the decision process. For a consumer that receives information on such quality indicators, the quality dimension may become more salient relative to the other characteristics, and as a result, she puts more weight on this dimension during the decision process. Hence, we view policies that increase the visibility of quality indicators as increasing the value of \( \lambda \) by making quality more salient.\(^4\)\(^5\)

2.2 Firm behaviour

Let there be \( n \geq 2 \) firms with equidistant locations along the circle. Firms compete to supply the differentiated product to consumers. For each firm, the cost of producing the good at quality \( q \) is \( k(q) = kq^2 \). We assume a constant marginal cost of production which is normalised to zero. A firm must also incur a fixed cost \( f > 0 \) to enter the market.

We consider two regimes: with and without regulated prices. In both cases, firms decide about market entry in the first period. In the second period, if the price is not regulated, firms set their prices and qualities simultaneously. On the other hand, if the price is regulated, firms only compete in qualities. We consider free entry in each regime, i.e., the equilibrium profit after entry is equal to the entry cost. Both regimes are common. For example, hospital prices are often regulated by the health insurance system, whereas care homes are typically free to decide on their prices. Relatedly, university tuition fees are highly regulated and/or subsidised in many countries such as Germany, the UK, and China, while private education providers are free to set their prices.

\(^4\)Whereas in our paper, the decision weight only depends on the publication of quality indicators, there is a growing literature that determines the saliency of product attributes endogenously within the choice context. For instance, in Bordalo et al. (2013, 2016), the decision weights are endogenous and the saliency of an attribute depends on how much an attribute varies within the choice set. Koszegi and Szeidl (2013) is a similar approach with a focus on intertemporal decisions. Closer to our paper, Zhou (2008) studies a model in which firms’ advertising messages lead consumers to overestimate the importance of one product attribute relative to others.

\(^5\)As an example, Choi et al. (2010) provide evidence that presenting information indeed shifts consumers’ focus. In their experimental study, consumers have to choose between four index funds. Consumers are more likely to choose a fund according to past performance when this information is highlighted. Similarly, consumers care more about prices when there is more price information.
3 The unregulated market

Consider first the case in which firms can freely set prices, i.e. firms compete both in prices and qualities.

We assume that horizontal differentiation among firms is sufficiently large:

**Assumption 1.** \( t > \frac{\lambda^2}{2k\gamma} \).

This assumption ensures that there is a positive level of entry, and that firms offer a positive level of quality.

Assume \( n \geq 2 \) firms have entered the market. We seek for a symmetric equilibrium. Assume all firms except firm \( i \), which is located at 0, choose quality \( q_o \) and price \( p_o \). The indifferent consumer located at \( d \) between firm \( i \) and its immediate neighbour at \( \frac{1}{n} \) is given by

\[
v + \lambda q_i - \gamma p_i - td = v + \lambda q_o - \gamma p_o - t \left( \frac{1}{n} - d \right).
\]

That is,

\[
d = \frac{1}{2n} + \frac{\lambda(q_i - q_o)}{2t} - \frac{\gamma(p_i - p_o)}{2t}.
\]

Firm \( i \)'s profits are

\[
\pi_i = 2d \cdot p_i + \frac{k}{2} q_i^2 = \left[ \frac{1}{n} + \frac{\lambda(q_i - q_o)}{t} - \frac{\gamma(p_i - p_o)}{t} \right] p_i - \frac{k}{2} q_i^2. \tag{1}
\]

Maximising (1) with respect to \( q_i \) and \( p_i \) and using symmetry gives the following equilibrium price and quality:

\[
\hat{q} = \frac{\lambda}{\gamma kn} \tag{2}
\]

and

\[
\hat{p} = \frac{t}{\gamma n}. \tag{3}
\]

Regarding the price, we see expected comparative statics. The price is increasing with the transport-cost parameter but drops with a larger number
of competitors. Quality provision is also decreasing with the number of firms. However, quality provision is higher if consumers have a larger decision weight on quality, as measured by $\lambda$. Of course, higher costs $k$ lead to less quality. Interestingly, both price and quality are decreasing with the co-payment share $\gamma$. A higher $\gamma$ makes demand more sensitive to price increases, and hence reduces the incentives to provide high quality.

Equilibrium profits are thus

$$\hat{\pi} = \frac{\hat{p}}{n} - \frac{k}{2} \hat{q}^2 = \frac{t}{\gamma n^2} - \frac{\lambda^2}{2\gamma^2 kn^2} = \frac{2\gamma tk - \lambda^2}{2k\gamma^2 n^2}.$$  

Assumption 1 implies that firms earn positive profits. This also implies that profits $\hat{\pi}$ decreases in $n$. Under free entry, the number of firms $n^*$ is determined by the zero-profit condition:

$$\frac{2\gamma tk - \lambda^2}{2k\gamma^2 n^2} = f.$$  

Hence,

$$n^* = \sqrt{\frac{2\gamma tk - \lambda^2}{2fk\gamma^2}}. \quad (4)$$

This implies the following quality and price level in the free-entry equilibrium:

$$q^* = \lambda \sqrt{\frac{2f}{k(2tk\gamma - \lambda^2)}}$$

and

$$p^* = t \sqrt{\frac{2fk}{2tk\gamma - \lambda^2}}.$$  

The following proposition describes the effects of increasing the visibility of quality (as measured by $\lambda$):

**Proposition 1.**  

i) An increase in $\lambda$ leads to higher quality, lower entry and higher prices.

ii) The effect of an increase in $\lambda$ on quality provision and on prices is stronger for lower co-payment rates, that is, $\frac{\partial^2 q^*/\partial \lambda \partial \gamma}{\partial^2 p^*/\partial \lambda \partial \gamma} < 0$ and
\[ \partial^2 p^*/\partial \lambda \partial \gamma < 0. \]

It is instructive to compare how the equilibrium changes with consumers’
decision weight on quality in the unregulated market. The first finding is
that quality provision and prices increase, whereas entry levels go down.\(^6\)
As a higher \(\lambda\) means that firms have higher incentives to invest in quality
for a given number of firms (see equation 2), entry levels go down as the
additional quality investments make it less profitable to enter the market in
the first place. With a smaller number of firms, prices also increase.

The second finding is that the effects of additional quality provision and
prices are larger in markets with more generous public finance systems (that
is, low co-payments). With a more generous public finance system, firms
mainly compete on quality, thus increasing the focus on quality, leading to
even higher investment levels.

Given that the release of quality indicators, which makes quality more visible
in consumers’ eyes, has positive effects (higher quality) as well as negative ef-
fects (higher prices, less variety) on consumers, it is a priori unclear whether
consumers benefit from such interventions or not. It is also unclear whether
social welfare increases. Given equilibrium behaviour, the surplus of con-
sumers and total welfare can be expressed as:

\[
CS^* = v - \frac{t}{4n^*} + q^* - \gamma p^* = v - \frac{\sqrt{2}f(5kt\gamma - 4\lambda)}{4\sqrt{k(2kt\gamma - \lambda^2)}}
\]

and

\[
W^* = v - \frac{t}{4n^*} + q^* - n^* \left( f + \frac{k}{2} q^* \right) = v - \frac{\sqrt{2}f(4kt + kt\gamma - 4\lambda)}{4\sqrt{k(2kt\gamma - \lambda^2)}}.
\]

Note that here the actual effect of quality on consumer surplus matters, not
the perceived surplus.

Differentiation with respect to \(\lambda\) gives the following findings:

\(^6\)There is indeed some evidence that quality disclosure leads to quality improvements.
See, for instance, Chou et al. (2014) and Filistrucchi and Ozbugday (2012) for hospitals and
Herr et al. (2016) for nursing homes.
Proposition 2.  
   i) In the unregulated market, the surplus of consumers increases (decreases) with decision weight $\lambda$ if $\lambda < (>) 8/5$.

   ii) Define $\tilde{\lambda} := 8\gamma/(4 + \gamma)$. In the unregulated market, total welfare increases (decreases) with decision weight $\lambda$ if $\lambda < (>) \tilde{\lambda}$.

   iii) As $\partial \tilde{\lambda}/\partial \gamma > 0$, an increase of the decision weight $\lambda$ is more likely to be welfare-reducing for lower co-payment shares.

Proposition 2 has two messages. First, if quality information in the market is poor, improving this information generates better outcomes in terms of consumer surplus and welfare. However, if this additional information induces consumers to put an excessively large weight on quality, market outcomes can worsen. Parts i) and ii) demonstrate this effect for the surplus of consumers and total welfare. Second, part iii) relates to the interaction of the public finance system and decision focus. It shows that additional quality information is more likely to be welfare-reducing if consumers receive heavy subsidies, that is, if co-payment levels are low. This follows as, with heavier subsidies prices receive a relatively low decision weight compared to quality provision. As in many such markets, consumers receive generous subsidies, it might indeed be the case that releasing quality information shifts consumer focus too much on quality such that quality is overprovided relative to the optimum, at the expense of higher prices and less variety.

It should be pointed out that the critical level of $\lambda$ for the negative welfare effects to materialise is not particularly large. The critical level in part i) of Proposition 2 is slightly larger than the rational benchmark of $\lambda = 1$. In part ii), the critical level of $\lambda$ can even be smaller than the rational benchmark of 1 if the level of public subsidy is sufficiently large.

Market entry

It is often debated whether or not the free market provides optimal variety. While in a standard spatial setup free entry seems to offer too much variety (Vickrey, 1964), this question is yet to be investigated in the current framework of varying decision weights. We note that social welfare for a fixed number of firms but allowing for free competition in qualities (2) and price
Let $t$ be sufficiently large, i.e., $t > \max\left\{ \frac{\lambda^2}{2k\gamma}, \frac{2\lambda(2\gamma-\lambda)}{\gamma^2k} \right\}$. Under this assumption, social welfare is maximised with respect to the number of firms at

$$n^* = \frac{1}{2\gamma} \sqrt{\frac{\gamma^2kt - 4\gamma\lambda + 2\lambda^2}{fk}}.$$  \hfill (5)

Comparing (4) with (5), we have the following result on entry.

**Proposition 3.** Define $\hat{\lambda} := \frac{\gamma + \sqrt{(3-\gamma)\gamma k t + \gamma^2}}{2}$. In the unregulated market, there is excessive (insufficient) entry when $\lambda < (>) \hat{\lambda}$.

The intuition follows from Proposition 1. As the decision weight on quality $\lambda$ increases, the number of entrants decreases in equilibrium. When $\lambda > \hat{\lambda}$, the equilibrium number of entrants falls below the socially optimal level and hence, entry becomes insufficient. The underlining mechanism for insufficient entry in the current paper, however, is different from that in, for example, Gu and Wenzel (2009) where the driving force is price sensitive demand.

It is also worth noting that the quality decision weight threshold $\hat{\lambda}$ increases in the co-payment share $\gamma$. That is, for a given decision weight on quality $\lambda$, entry is more likely to be insufficient when consumers are more heavily subsidised.

## 4 The regulated market

We now consider the situation in which prices are regulated which is, for instance, relevant in hospital markets where typically treatment charges are fixed, and hospitals are not free to compete on prices. Similarly, universities
in the UK face regulated tuition fees but are free to invest in qualities by providing better learning facilities, attracting more prominent academics, etc. In addition, we consider a setting with complete commitment power, so that the regulator is able to set the price before entry takes place.

4.1 Competition in the regulated market

We will start our analysis by looking at the case where the price is exogenously given by \( p_r \). We impose the following assumption on parameter values which ensures that in equilibrium there is a positive level of entry and firms offer a positive quality level:

**Assumption 2.** \( t > \lambda \frac{s-k}{8k} \).

Given that the price is regulated at the level \( p_r \), the indifferent consumer is given by

\[
v + \lambda q_i - \gamma p_r - td = v + \lambda q_o - \gamma p_r - t \left( \frac{1}{n} - d \right)
\]

\[
\Leftrightarrow d = \frac{1}{n} + \frac{\lambda(q_i - q_o)}{t}.
\]

Note that as prices are regulated at the same level, the co-payment rate has no influence on consumers’ decision making and, as a result, has also no effect on firms’ incentives to invest in quality.

Firm \( i \)'s profit becomes

\[
\pi_i = p_r \left[ \frac{1}{n} + \frac{\lambda(q_i - q_o)}{t} \right] - \frac{k}{2} q_i^2.
\]

Equilibrium quality is thus given by

\[
\bar{q} = \frac{\lambda p_r}{tk}.
\]

(6)

Equilibrium profits are

\[
\bar{\pi} = \frac{p_r}{n} - \frac{k}{2} \bar{q}^2.
\]

(7)
and hence the number of firms under free entry is

\[ \bar{n} = \frac{p_r}{f + \frac{k}{2}q^2} = \frac{2kt^2p_r}{2tf + \lambda^2p_r^2}. \quad (8) \]

From profits (7) and entry (8) one can see that a higher price \( p_r \) has two effects on the firms’ entry decisions. On the one hand, a higher price induces more entry by increasing the profit margin of each firm. On the other hand, a higher price also leads to increased quality investments (see equation 6), leading to higher investment cost and less entry. The following lemma shows that either effect can dominate:

Lemma 1. i) Define \( \hat{p}_r := t\sqrt{2fk}/\lambda \). Then, a higher regulated price \( p_r \) increases (decreases) entry if \( p_r < (>) \hat{p}_r \). \( \hat{p}_r \) negatively depends on \( \lambda \).

ii) An increase in \( \lambda \) leads to higher quality and lower entry.

In Lemma 1 we also note that, as in the unregulated market, a higher decision weight on quality \( \lambda \) reduces the incentives to enter the market. A higher \( \lambda \) is associated with higher quality investment cost which act as an additional entry cost. This mechanism is qualitatively similar to the effect in the unregulated market in which firms also compete in prices.

For given prices, the surplus of consumers and total welfare are given by

\[ CS = V + q - \frac{t}{4n} - \gamma p_r \]

and

\[ W = V + q - \frac{t}{4n} - n\left(\frac{k}{2}q^2\right) - nf. \]

Using the competitive level of quality (6) and entry (8) induced by a regulated price of \( p_r \), we have

\[ CS = V + \frac{8\lambda p_r^2 - \lambda^2 p_r^2 - 2fkt^2}{8tp_rk} - \gamma p_r \]

and

\[ W = V + \frac{8\lambda p_r^2 - \lambda^2 p_r^2 - 2fkt^2 - 8kp_r^2t}{8tp_rk}. \quad (9) \]
The following proposition evaluates the impact of \( \lambda \) on welfare measures.

**Proposition 4.** In the regulated market with exogenous price, the surplus of consumers and total welfare increase (decrease) with a higher decision weight \( \lambda \) if \( \lambda < 4 \) \((\lambda > 4)\).

The proposition reveals that also in a regulated market, the surplus of consumers and total welfare may decrease with higher values of \( \lambda \). In both cases, the welfare effects are negative if the decision weight is excessively large. The trade-offs for consumers concern a positive effect of higher quality but less variety. Regarding total welfare, there is an additional negative effect via the costs of providing quality.

### 4.2 Optimal price regulation

So far in our analysis, we considered the price in a regulated market as fixed exogenously. Here, we consider the implications if a regulator can set the price as to maximise total welfare in the market. We focus on full commitment power. With full commitment power, the regulator commits to a fixed price \( p_r \) before firms enter and choose their quality levels. We are interested in understanding how a regulator should regulate this price and the resulting welfare consequences of increasing quality visibility with an endogenously regulated price.

By maximising expression (9), we can determine the optimal regulated price as

\[
p^*_r = t \sqrt{\frac{2fk}{8kt + \lambda^2 - 8\lambda}}.
\]

**Lemma 2.** The optimal price is increasing in \( \lambda \) for \( \lambda < 4 \), and decreasing for \( \lambda > 4 \).

Lemma 2 shows there is an inverted u-shaped relation between the regulated price and \( \lambda \). For low values, the optimal price is increasing, whereas it is decreasing for higher levels. The intuition is as follows. As with higher \( \lambda \) firms invest more in quality, investment costs rise and entry goes down.
By increasing the price the regulator can dampen such effects. This is the dominating effect when $\lambda < 4$ and the regulated price increases in $\lambda$ over this range. On the other hand, the regulator can also dampen potentially excessive incentives to invest into quality by reducing the price $p_r$. As with high values of $\lambda$, firms have strong incentives to increase quality, the regulator reacts by reducing $p_r^*$ for sufficiently high levels of $\lambda$.

The optimally regulated price induces the following levels of quality and entry:

$$q^* = \lambda \sqrt{\frac{2f}{k(8kt + \lambda^2 - 8\lambda)}}$$

and

$$n^* = t \sqrt{\frac{k(8kt + \lambda^2 - 8\lambda)}{\sqrt{2f(4kt + \lambda^2 - 4\lambda)}}}.$$

Note that by Assumption 2 equilibrium entry and quality are positive. We can now examine the effects of the publication of quality indicators, as measured by an increase in $\lambda$ on the key outcomes, quality and entry:

**Lemma 3.** i) Let $\tilde{\lambda}_1 := 2kt$. Then, quality provision is increasing (decreasing) in $\lambda$ for $\lambda < (>) \tilde{\lambda}_1$.

ii) Let $\tilde{\lambda}_2$ be implicitly defined by $(12kt\tilde{\lambda}_2 + 3\tilde{\lambda}_2^2 - 16kt - 12\tilde{\lambda}_2^2 + 16\tilde{\lambda}_2) = 0$. Then, entry is increasing (decreasing) in $\lambda$ for $\lambda < (>) \tilde{\lambda}_2$.

It is interesting to note that increasing $\lambda$ has a non-monotonic effect on quality levels. For low levels of $\lambda$, quality provision is increasing, whereas it is decreasing for higher levels. This is different to the case of the non-regulated market in which equilibrium quality provision is strictly increasing with the visibility of quality to consumers. In the regulated market, as $\lambda$ increases, the regulator finds it worthwhile to reduce the price as to curb (excessive) investment in quality by reducing payments to the firms (see Lemma 2). Moreover, over some region, the number of firms in the market is increasing, dampening the incentives to invest in quality.

Given optimally regulated prices, a higher level of $\lambda$ does not necessarily lead to lower entry levels (compared to the unregulated case). This is because,
at least for low levels of \( \lambda \), the optimal price is also increasing in \( \lambda \), as the regulator wants to prevent lower entry levels.

We are now in a position to evaluate the welfare effects of publishing quality indicators:

**Proposition 5.** In the regulated market with optimal prices, the surplus of consumers and total welfare are increasing (decreasing) in \( \lambda \) for \( \lambda < (>)4 \).

As in the unregulated market, publishing quality indicators may reduce the consumers’ surplus and total welfare if consumers place an excessive weight on quality when making decisions. However, the scope for this surplus-reducing effects is much smaller in the regulated market, assuming that the regulator determines the price in an optimal way. This finding arises as the critical parameter levels of \( \lambda \) for the welfare-decreasing effect to arise is strictly smaller in the unregulated market. In the regulated market, via reducing prices, the regulators can limit these negative effects. Moreover, it can also affect the entry level by adjusting regulated prices. This intuition follows from Lemmas 2 and 3.

## 5 Conclusion

This paper offers a model of how the publication of quality indicators affects competition between service providers (firms). In our setting, we model the release of quality scores as an increase of the decision weight on the quality variable, relative to other attributes (such as prices). We argue that reporting quality scores increases the visibility of quality, and therefore consumers are likely to attach a larger weight to this attribute during their decision process. In our model, the number of firms is endogenous and depends on the competitiveness of the market. We contrast the effects in markets in which prices are regulated (such as hospitals or universities) and those in which prices can be set by firms (such as care homes).

The results of our analysis have implications for policy design. Our main message is that increased information may have ambiguous effects on market performance. In the unregulated market, we find that increased information
leads to higher quality investments, which is the intended effect of such policy interventions. However, we also identify unintended effects of such interventions: The positive effect of higher quality is countered by higher prices and lower product variety. As a result, the surplus of consumers and total welfare increase with better information if the initial weight of the quality attribute is low, but decreases if consumers put a large weight on the quality dimension. Importantly, there is also an interaction with the degree of public finance system. Increasing information is more likely to have adverse effects if consumers are heavily subsidised.

We find qualitatively similar effects for the case of regulated prices. Also, in the case of regulated markets, releasing quality scores may have detrimental welfare effects, but compared to an unregulated market the scope for this to happen is much smaller. However, we also note that quality disclosure can be complementary to price regulation. The optimal price is non-monotonic in the degree of information. As consumers attach excessive weight to quality, optimal regulation reacts by reducing the regulated prices.

References


